Executive Summary

The ocean monitoring program for the South Bay Ocean Outfall (SBOO) is conducted in accordance with NPDES permit requirements for the South Bay Water Reclamation Plant (SBWRP) operated by the City of San Diego and the International Wastewater Treatment Plant (IWTP) operated by the International Boundary and Water Commission. These documents specify the terms and conditions that allow treated effluent originating from the SBWRP and IWTP to be discharged into the Pacific Ocean via the SBOO. In addition, the Monitoring and Reporting Programs contained within each permit define the requirements for monitoring the receiving waters environment, including sampling plans, compliance criteria, laboratory methods, data analysis and reporting guidelines.

The main objectives of the South Bay monitoring program are to provide data that satisfy the requirements of the NPDES permits, demonstrate compliance with the 2001 California Ocean Plan (COP), monitor dispersion of the waste field, and identify environmental changes that may be associated with wastewater discharge. Specifically, the program is designed to assess the impact of wastewater on the marine environment off southern San Diego, including the effects on water quality, sediment conditions, and the marine biota. The study area centers around the SBOO discharge site, which is located approximately 5.6 km offshore at a depth of about 27 m. Monitoring at sites along the shore extends from Coronado southward to Playa Blanca, Mexico. Offshore monitoring is conducted in an adjacent area overlying the coastal continental shelf at sites ranging in depth from about 9 to 55 m.

Prior to the initiation of wastewater discharge from the IWTP in 1999, the City of San Diego conducted a 3½-year baseline study designed to characterize background environmental conditions in the South Bay region in order to provide information against which post-discharge data could be compared. Additionally, a region-wide survey of benthic conditions is typically conducted each year at randomly selected sites from about Del Mar to the US/Mexico border as part of the NPDES permit requirements. Such studies are useful for evaluating patterns and trends over a broader geographic area, thus providing additional information to help distinguish reference areas from sites impacted by anthropogenic influences. The results of the 2005 annual survey of randomly selected stations are presented herein.

The receiving waters monitoring effort for the South Bay region may be divided into several major components, each comprising a separate chapter in this report: Oceanographic Conditions, Microbiology, Sediment Characteristics, Macrobenthic Communities, Demersal Fishes and Megabenthic Invertebrates, and Bioaccumulation of Contaminants in Fish Tissues. Data regarding various physical and chemical oceanographic parameters are evaluated to characterize water mass transport potential in the region. Water quality monitoring along the shore and in offshore waters includes the measurement of bacteriological indicators to assess both natural (e.g., river and streams) and anthropogenic (e.g., storm water and wastewater) impacts. Benthic monitoring includes sampling and analyses of soft-bottom macrofaunal communities and their associated sediments, while communities of demersal fish and megabenthic invertebrates are the focus of trawling activities. The monitoring of fish populations is supplemented by bioaccumulation studies to determine whether or not contaminants are present in the tissues of "local" species. In addition to the above activities, the City, the International Boundary and Water Commission, and the San Diego Regional Water Quality Control Board (RWQCB) support other projects relevant to assessing ocean quality in the region. One such project is a remote sensing study of the San Diego/Tijuana coastal region, the results which are incorporated herein into the interpretations of oceanographic and microbiological data (see Chapters 2 and 3).

The present report focuses on the results of the ocean monitoring activities conducted in the South Bay

region during calendar year 2005, including results of the July 2005 random sample. An overview and summary of the main findings for each of the major components are included below.

OCEANOGRAPHIC CONDITIONS

Oceanographic conditions in the South Bay region were generally similar to previously observed seasonal patterns. Thermal stratification of the water column followed the typical cycle with maximum stratification in mid-summer and reduced stratification during winter. Higher-than-normal air temperatures from January through March yielded slightly warmer than normal surface waters early in the year. In contrast, water clarity was negatively impacted by the pattern of record rainfall that began in October 2004 and continued through February 2005. These persistent rains generated heavy runoff into nearshore waters and long-lasting turbid conditions. Aerial imagery from the remote sensing study indicated that runoff from the Tijuana River was the most significant contributor to increased turbidity through May 2005. This runoff, which contained agricultural and effluent materials from the Tijuana River, combined with cooler, nutrient-rich upwelled water to create favorable conditions for an intense plankton bloom. These storm and plankton bloom events lead to decreased surface water clarity in 2005 relative to 2004. In general, data from both oceanographic measurements and aerial imagery provide no evidence that any water quality parameter (e.g., dissolved oxygen, pH) has changed because of wastewater discharged from the SBOO. Instead, these data indicate that natural events such as storm water runoff or plankton blooms were significant factors in increased turbidity and changed water quality parameters to the South Bay region in 2005.

MICROBIOLOGY

The greatest effects on nearshore water quality conditions in the South Bay region in 2005 appeared to be associated with the above average rainfall during winter. The resultant runoff from the Tijuana River and Los Buenos Creek generated elevated bacterial densities that contributed to the low overall rates of shore and kelp station compliance with COP standards. This pattern was similar to that seen in 2004 when record rainfall in February, October, and December affected nearshore bacteriological densities. Data from monthly offshore monitoring sites suggested that the wastewater plume was predominantly confined below a stratified water column from March through October. Bacterial counts indicative of wastewater were evident in surface waters during January when the water column was well-mixed, and in June when upwelling was apparently responsible for bringing the wastewater plume to surface waters. Overall, data from shore, kelp, and monthly water quality stations suggest that elevated bacterial counts detected along the shore in 2005 were not caused by the shoreward transport of wastewater from the outfall. Instead, the distribution and frequency of high bacterial counts in nearshore waters correspond to inputs and transport of materials from the Tijuana River and Los Buenos Creek, particularly during the rainy season.

SEDIMENT QUALITY

The composition and quality of ocean sediments in the South Bay area were similar in 2005 to those observed during previous years. Sediments at most sites were dominated by fine sands with grain size tending to increase with depth within the sampling region. Stations located offshore and southward of the SBOO discharge area consisted of very coarse sediments, while sites located in shallower water and north of the outfall towards San Diego Bay had finer sediments. Spatial differences in sediment composition can be partly attributed to patches of sediments associated with different origins (e.g., relict red sands, other detrital material). For example, the deposition of sediments from the Tijuana River and to a lesser extent from San Diego Bay probably contributes to the higher content of silt at nearby stations. In contrast, the strong and

persistent storms of 2004–2005 contributed to the erosion of beach sand from the Silver Strand area. This beach erosion seems to be reflected in greater number of stations categorized as having poorly sorted sediments since July 2004.

As in previous years, there was no evidence that discharged wastewater from the SBOO negatively impacted contaminant concentrations in South Bay area sediments. Concentrations of organic indicators such as total organic carbon, total nitrogen and sulfides, as well as various trace metals were generally low in South Bay sediments relative to other coastal areas off southern California. However, there was an overall increase in total organic carbon relative to the previous year that may be related to the increased turbid discharge from San Diego Bay and the Tijuana River, as well as a strong and persistent plankton bloom. In general, the highest organic indicator and metal concentrations were generally associated with finer sediments. In addition, other contaminants (e.g., pesticides, PCBs) were detected infrequently or at low levels. For example, derivatives of the pesticide DDT were found in sediment samples from only three sites in 2005. The presence of DDT does not appear to be related to wastewater discharge since it was present at these sites prior to outfall construction. In addition, seven PCBs were detected in sediments from one station near the entrance to San Diego Bay in 2005. Finally, although PAH compounds were detected more frequently than in previous years, their concentrations were very low. Overall analyses of particle size or sediment chemistry data collected in 2005 provide no indication of contamination attributable to the SBOO.

MACROBENTHIC INVERTEBRATE COMMUNITIES

Benthic communities in the SBOO region included macrofaunal assemblages that varied along gradients of sediment structure (e.g., grain size) and depth (e.g., shallow vs. mid-depth waters). During 2005, assemblages surrounding the SBOO were similar to those that occurred during previous years. Most sites (70%) were represented by 2 groups of stations with very similar species composition. These sites were dominated by the spionid polychaete *Spiophanes bombyx*, a species characteristic of other shallow-water assemblages in the Southern California Bight (SCB). Another type of assemblage occurred at 6 sites from slightly deeper water where the sediments contained finer particles. Although this assemblage was also dominated by *S. bombyx*, it was distinguished from the shallow-water assemblage by more dense populations of the polychaetes *Myriochele gracilis* and *Sthenelanella uniformis*, the amphipod *Ampelisca agassizi,* and the tanaid *Leptochelia dubia*. This assemblage probably represents a transition between assemblages occurring in shallow sandy habitats and those occurring in finer mid-depth sediments off southern California. Finally, sites with sediments composed of relict red sands or varied amounts of coarse sand and shell hash were also characterized by unique assemblages.

Patterns of species richness and abundance also varied with depth and sediment type in the region, although there were no clear patterns with respect to the outfall. The range of values for most community parameters in 2005 was similar to that seen in previous years, and values of environmental disturbance indices such as the BRI and ITI were characteristic of undisturbed sediments. In addition, changes in benthic community structure near the SBOO that occurred in 2005 were similar in magnitude to those that have occurred previously and elsewhere off southern California. Such changes often correspond to large-scale oceanographic processes or other natural events. Overall, benthic assemblages in the region remain similar to those observed prior to discharge and to natural indigenous communities characteristic of similar habitats on the southern California continental shelf. The data from present monitoring efforts provide no evidence that the SBOO wastewater discharge has caused any substantial degradation of the benthos in the area.

DEMERSAL FISH AND MEGABENTHIC INVERTEBRATE COMMUNITIES

As in previous years, speckled sanddabs continued to dominate South Bay fish assemblages in 2005. Although the numbers of speckled sanddabs declined markedly from the previous year, this species occurred at all stations and accounted for 65% of the total catch. Other characteristic, but less abundant, species included the yellowchin sculpin, California lizardfish, roughback sculpin, longfin sanddab, English sole, Californa scorpionfish, and California tonguefish. Most of these common fishes were relatively small, averaging less than 23 cm in length. Although the composition and structure of the fish assemblages varied among stations, these differences were mostly due to variations in speckled sanddab populations.

Assemblages of relatively large (megabenthic) trawl-caught invertebrates were similarly dominated by one prominent species, the sea star *Astropecten verrilli.* Two other echinoderms, the white urchin *Lytechinus pictus* and the sea star *Pisaster brevispinus* were also common. Although megabenthic community structure also varied between sites, these assemblages were generally characterized by low species richness, abundance, biomass and diversity.

Overall, results of the trawl surveys conducted in 2005 provide no evidence that the discharge of wastewater has affected either fish or megabenthic invertebrate communities in the region. Although highly variable, patterns in the abundance and distribution of species were similar at stations located near the outfall and further away. Finally, the absence of any physical abnormalities or evidence of disease on local fishes suggests that populations remain healthy in the region.

TISSUE CONTAMINANTS IN FISHES

There was no clear evidence to suggest that tissue contaminant loads were affected by the discharge of wastewater from the SBOO in 2005. Although various contaminants were detected in both liver and muscle tissues, concentrations of most contaminants were not substantially different from those reported prior to discharge. In addition, samples of muscle tissues from sport fish collected in the area were found to be within FDA human consumption limits for both mercury and DDT.

The occurrence of both metals and chlorinated hydrocarbons in the tissues of South Bay fishes may be due to many factors, including the ubiquitous distribution of many contaminants in coastal sediments off southern California. Other factors that affect the accumulation and distribution of contaminants include the physiology and life history of different fish species. Exposure to contaminants can vary greatly between species and even among individuals of the same species depending on migration habits. Fish may be exposed to pollutants in a highly contaminated area and then move into a region that is less contaminated. This is of particular concern for fishes collected in the vicinity of the SBOO, as there are many other point and non-point sources that may contribute to contamination in the region.

SAN DIEGO REGIONAL SURVEY

Sediment Conditions

Thirty-six randomly selected sites ranging in depth from 12 to 190 m were sampled during the 2005 regional survey. Overall, the sediments reflect the diverse and patchy habitats common to the SCB. The data were summarized according to depth strata used in the 1998 and 2003 SCB region wide surveys (Bight′98, Bight′03). Stations between about 31 and 120 m in depth represent most of the mid-shelf region off San Diego (n=24). Sediments at these sites were composed primarily of fine particles (36% fines) with an average particle size of 0.088 mm. By comparison, sites occurring at depths ≤30 m (n=7) had coarser sediments with only 8.5% fines and an average particle size of approximately 0.262 mm. Deeper sites (>120 m, n=5) contained sediments of 0.175 mm average particle size, including 73% sand and 30% fines.

Coarse sediments (~85% sand) occurred in 2 distinct locations: (1) in shallow waters, and (2) along a the Coronado Bank, a southern rocky ridge located offshore of Point Loma at a depth of 150–170 m. Relict sediments typical of the area offshore of the Tijuana River were found at 1 site located west of the SBOO. These results were similar to the patterns seen during previous annual surveys. Shallow water (19 and 28-m) stations included in the regular semi-annual sampling grid surrounding the SBOO were generally similar to the shallow water sites from the survey. In contrast, stations from the two deeper semi-annual transects (38 and 55-m) were composed of more sand and less fine materials than comparable mid-shelf samples. This difference may relate to the greater number of grid stations located south of the SBOO and U.S.-Mexico border where relict sands are more common.

Sediment chemistries followed the expected relationship of elevated concentrations with decreasing particle size and increasing depth. The highest values for total organic carbon (TOC), total nitrogen (TN), sulfides, and trace metals occurred in the mid-shelf region where fine sediments were prevalent. For example, mean TOC values were 0.35% at the shallow water stations, 0.73% at the mid-shelf stations, and 3.87% at the 5 deep water sites. Similarly average concentrations of trace metals in the sediments from the mid-shelf and deep water strata were much higher than sediments in the shallow water areas. Concentrations of organic indicators and trace metals were higher and more widespread in 2005 compared to the 1995 survey of the same randomly selected stations. Sediments at 24 of the stations sampled in 2005 contained percentages of TOC or TN that exceeded the median CDF for the SCB established in 1994, while only 4 stations exceeded this benchmark in 1995. In addition, 21 stations contained concentrations of 3 or more metals that exceeded the median CDF values in 2005, while 11 did so in 1995. Contaminant levels at the shallow stations included in the SBOO semi-annual sampling grid were similar to the shallow water strata samples, whereas sediments at the 38 and 55-m stations had lower levels of organics or trace metals than comparable mid-shelf samples. Overall, the 2005 regional survey data did not show any pattern of impact relative to wastewater discharge from the SBOO.

Macrobenthic communities

The Southern California Bight (SCB) benthos has long been considered a "patchy" habitat, with the distribution of species and communities varying in space and time. Barnard and Ziesenhenne described the SCB shelf as consisting of an *Amphiodia* "mega-community" with other sub-communities representing simple variations determined by differences in substrate type and microhabitat. Results of the 2005 and previous regional surveys off San Diego generally support this characterization. The 2005 benthic assemblages were very similar to those sampled at the same sites 10 years previously (1995) and segregated mostly due to differences in habitat type (e.g., depth and sediment grain size). There was little evidence of anthropogenic impact. Over 50% of the benthos off San Diego was characterized by one assemblage with the ophiuroid *Amphiodia urtica* representing the dominant species. Co-dominant species within this assemblage included other taxa common to the region such as the polychaetes *Myriochele striolata* and *Spiophanes duplex.* This group occurred along the mainland shelf at depths from 44 to 94 m, and in sediments composed of relatively fine particles (e.g., 40% fines).

The dominant species of the other assemblages occurring in the region varied according to the sediment type or depth. Shallow water assemblages (e.g., <30 m) were highly variable depending upon their sediment type, but these assemblages generally were similar to other shallow, sandy sediment communities in the SCB. At many of these stations, polychaete species such as *Spiophanes duplex* and *S. bombyx*, *Hesionura coineaui difficilis, Ampharete labrops,* and *Monticellina siblina* were numerically dominant. A deep water assemblage located at depths >180 m was dominated by the polychaetes *Aphelochaeta glandaria* and *Monticellina siblina,* and the mollusc *Huxleyia munita*. These sites had the

highest percentage of fine particles with the lowest species richness, diversity and abundance.

Although there was a overall increase in the number of species and individuals as well as changes in community parameters between the 1995 and 2005 random surveys, the two surveys identified identical assemblages based on depth and sediment type. The influence of increased organic loading or metals contamination detected in the 2005 appears to have had little impact on overall structure of the benthos.